

Crop Nitrate Availability and Nitrate Leaching under Micro-Irrigation for Different Fertigation Strategies

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Project Objectives

1. To determine fertigation strategies for microirrigation systems using state-of-the-art modeling tools to improve water and nutrient use efficiencies and to reduce leaching of nitrates and other nutrients and chemicals;
2. To develop jointly a publication and slide show for our target audience, highlighting the recommendations using color graphics of two-dimensional simulation results to illustrate the effect of proposed fertigation strategies on the movement of nitrate for various microirrigation systems.

Abstract

Microirrigation has the potential to apply water and nutrients both precisely and uniformly throughout a field. However, under microirrigation, water, nutrients, and roots vary spatially around the drip line with the highest water contents and generally the highest root density near the drip lines. Because of this localized variability, it is possible to apply nutrients in a manner such that much of the nutrient is transported beyond the zone of higher root densities, thus potentially reducing the nutrient's availability for plant uptake and increasing leaching of the nutrient.

A recommendation by the drip irrigation industry is to fertigate (application of the nutrient through the microirrigation system) during the middle third or middle half of the irrigation cycle to spread the nutrient throughout most of the wetted soil. However, a common practice by growers is to apply fertilizers for a short time period. The fertigation strategy (duration of fertigation event and timing of the fertigation during the irrigation cycle) could affect the localized distribution of the nutrient around the drip lines.

The main objective of this project was to determine the effect of fertigation strategy and soil type on nutrient availability and leaching using a computer simulation model (HYDRUS-2D) to determine nutrient distributions around drip lines. The first phase used a nitrate-only fertilizer. Nitrate distributions were determined for five fertigation strategies using four different types of microirrigation systems and four soil types. The second phase investigated the nutrient distribution of phosphorus, potassium, nitrate,

ammonium, and urea using three fertigation strategies, two types of microirrigation systems and one soil type.

We concluded that fertigation at the beginning of the irrigation cycle tends to increase seasonal nitrate leaching. In contrast, fertigation events at the end of the irrigation cycle showed reduced nitrate leaching potential. We found that seasonal leaching was the highest for coarse-textured soils. Ammonium, phosphorus, and potassium were strongly adsorbed to soil particles, and as a result, the fertigation strategy had little effect on their distribution in the soil.

Recommendations for Fertigation with Microirrigation

Based on these results along with results from other studies and field experiences, the following are recommended for fertigation with microirrigation:

- Do not start injection until irrigation water has reached the end of the irrigation system
- Inject for sufficient time for the chemical to reach the end of the irrigation system
- After injection, flush system with irrigation water until the fresh water reaches the end of the irrigation system
- Avoid long periods of water application after injection of fertilizers that are mobile
- Maintain high uniformity of emitter discharge rates throughout the irrigation system
- Use good irrigation water management techniques
- Apply the right amount of fertilizer